FRESHWATER CRAYFISH OF THE WILSON INLET CATCHMENT BASIN, SOUTHWEST WESTERN AUSTRALIA

By RUSSELL W. JONES,
University of Massachusetts at Amherst,
Hills House, Amherst MA 01003, U.S.A.

ABSTRACT

A survey of three rivers in the Wilson Inlet catchment basin in southwest Western Australia was undertaken during an eight day period in May 1981, to describe the distribution of *Cherax* spp.

Four species of *Cherax* were recorded: *C. tenuimanus*, *C. crassimanus*, *C. quinquecarinatus* and *C. preissii*. The presence of *C. quinquecarinatus* extended the known distribution of this species eastward by some 29 kilometres. *C. crassimanus* occurred within all river systems. *C. tenuimanus* was found predominantly in permanent waters particularly of the Denmark River, the catchment of which has suffered minimal disturbance. *C. preissii* was found only in the Hay and Sleeman River systems where catchments have suffered greater disturbance.

Increases in salinity concomitant with the clearing of catchment may be an important mechanism controlling the distribution of the crayfish species.

INTRODUCTION

If size, abundance and distribution are relevant criteria by which to judge, then crayfish must be significant components of Australian freshwater ecosystems. There would be, therefore, zoological relevance for determining the distribution and macrohabitat preference of crayfish species under pristine environmental conditions. Yet intensive studies on these facets of the biology of Australian crayfish commenced in only comparatively recent times: studies on *Engaeus* spp. and *Parastacoides tasmanicus* in western Tasmania (Richardson and Swain 1980; Suter and Richardson 1977) and *Cherax tenuimanus* in Western Australia (Morrissy 1978).

The freshwater crayfish of Australia all belong to the family Parastacidae which has a Gondwanic distribution. Parastacids of the genus *Cherax* are

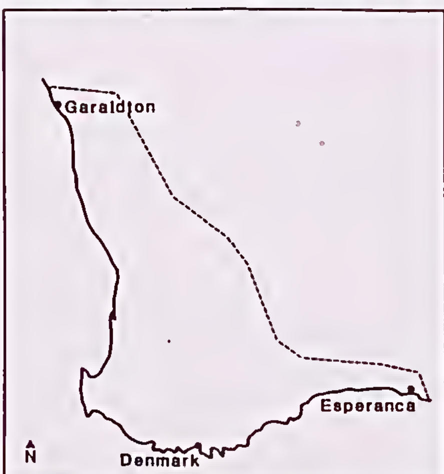

Figure 1. The distribution of the genux *Cherax* within southwest Australia.

the most widespread within the southwestern corner of Western Australia (Figure 1), inhabiting a variety of macrohabitats from deep permanent rivers to semi-permanent swamps and creeks (Coy 1979; Riek 1967). Riek (1967) presents general distribution maps of each species.

This paper presents the results from a survey of *Cherax* distribution within the Denmark, Hay and Sleeman River catchments. Although adjacent, all represent quite separate catchments (Figure 2). However, during the last

Figure 2. Map plus insert showing sample sites within the Wilson Inlet catchment basin.

glacial period, which exhibited significantly lowered sea level (Merrilees 1979), all three rivers were tributaries of one river system with common outflow through what is now Wilson Inlet. Given this, and the reasonably uniform topography, geology and climate throughout the area, it is reasonable to anticipate that any differences in distribution of *Cherax* spp. within the Denmark, Hay and Sleeman catchments reflect the disturbance due to increased salinity and land clearance associated with agriculture in the latter two catchments. The catchment of the Denmark River remains essentially unchanged jarrah-marri forest.

METHODS

Sampling was undertaken from 11 May 1981 to 17 May 1981 at a total of 28 sites within the Wilson Inlet catchment basin. The sample sites are indicated on Figure 2. Locations varied from perennial shallow swamp habitats to permanent deep flowing river habitats. Each site was sampled on a minimum of two occasions, at least once during the day and again at night.

In water greater than waist deep, drop-nets of mesh size 16 mm, baited with chicken laying pellets, were positioned for periods of half an hour in such a manner as to sample as many of the potential habitats of the sample sites as possible i.e., at any one site under logs, in deep pools and in fast flowing water. At sites where wading was possible hand nets with diameter no greater than 450 mm were used to sweep the site, under banks, around and under submerged rocks and logs.

Animals were identified to species level. To ensure accuracy and reliability of my classification, a number of specimens were stored in alcohol and their identification was verified by C.M. Austin, Zoology Department, University of Western Australia. Any crayfish of carapace length less than 10 mm were disregarded as accurate identification was not possible. Identification of *Cherax* spp. is not easy. Riek (1967) listed eight species endemic to Western Australia, but in a preliminary investigation, Austin (1986) reduced this number to five. Another species, *C. destructor* has also been introduced into the wheatbelt.

RESULTS

The sites where crayfish were caught, and numbers collected at each site are listed in Table 1. Crayfish were collected at 23 sites representing 82% of all sampling stations.

Site	*C. tenuimanus*	*C. crassimanus*	*C. preissii*	*C. quinquecarinatus*
01	1	1	–	–
02	–	1	–	–
03	1	3	–	–
04	2	3	–	–
05	2	–	–	–
06	14	2	–	3
07	4	–	–	–
08	1	–	–	–
09	1	1	–	–
10	–	2	–	–
11	9	1	–	–
12	–	2	–	–
13	–	1	–	–
14	–	–	–	–
15	–	–	–	7
16	–	–	–	–
17	–	3	–	–
18	–	2	–	–
19	–	6	2	–
20	–	–	–	–
21	–	1	2	–
22	–	–	10	–
23	–	2	2	–
24	–	–	–	–
25	2	–	5	–
26	–	4	5	–
27	–	3	–	–
28	–	–	–	–

Table 1. Numbers of crayfish of each species caught at each site.

Four species are represented in the samples: *C. tenuimanus* at 10 sites, *C. crassimanus* at 17 sites, *C. preissii* at 6 sites and *C. quinquecarinatus* at 2 sites. Allopatry was exhibited at 57.2% of sample sites and included all four species. Sympatry was also found to occur — between *C. tenuimanus* and *C. crassimanus* at sites 1, 3, 4, 9 and 11; between *C. tenuimanus* and *C. preissii* at site 25; between *C. crassimanus* and *C. preissii* at sites 19, 21, 23 and 26; and between *C. tenuimanus*, *C. crassimanus* and *C. quinquecarinatus* at site 6.

The river systems were divided into two regions, a "channel" region including all permanent bodies of water continuously connected to the ocean and a "headwater" region including all temporary bodies of water connected downstream to an intermittent water body. This zonation, although simple, has the advantage of encompassing the wide range of seasonal and yearly water flow found in the southwest of Western Australia. Furthermore, permanency is likely to be the single most direct factor affecting the physical and hence biological composition of freshwater bodies in Western Australia. During the limited period of the study, all rivers were flowing strongly throughout their entire lengths. Species distribution according to this zonal classification within the three catchments is presented in Table 2. Eighty-six percent of C. *tenuimanus* individuals caught were in the permanent waters of the channel region. In contrast, 67% of C. *crassimanus* specimens were captured in the intermittent waters of the headwater region. Neither C. *preissii* nor C. *quinquecarinatus* exhibited any marked preference for either region.

	DENMARK SYSTEM		HAY SYSTEM		SLEEMAN SYSTEM	
	Headwater	Channel	Headwater	Channel	Headwater	Channel
C. tenuimanus	5(3)	29(5)	–	–	–	2(1)
C. crassimanus	7(3)	8(5)	14(5)	–	3(1)	4(1)
C. preissii	–	–	16(4)	–	–	10(2)
C. quinquecarinatus	–	3(1)	7(1)	–	–	–

Table 2. Number of crayfish (and sites) of each *Cherax* spp. found within the three river systems.

The distribution of each species in relation to salinity is illustrated in Figure 3. The graph indicates a preference by C. *tenuimanus* for water of salinity less than 600 mg/L while C. *crassimanus* and C. *preissii* would appear to favour extreme salinity.

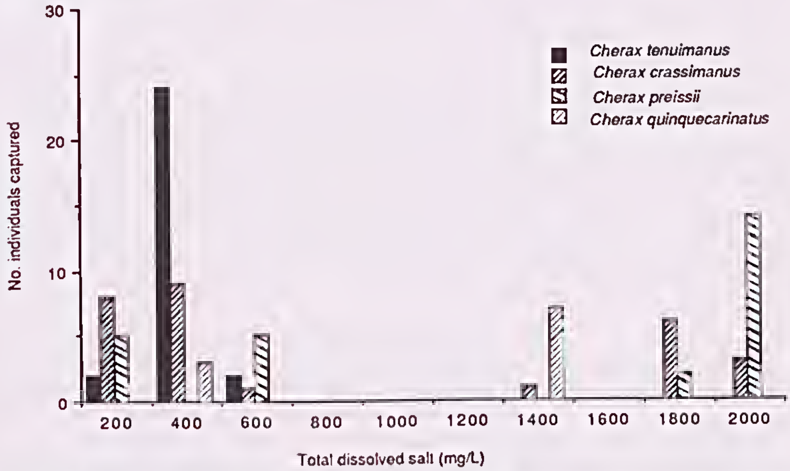

Figure 3. Number of crayfish caught versus average total salt concentration (average salinity over two years after the data of Collins and Fowlie [1981]).

DISCUSSION

Clearing of forests, particularly for agricultural purposes, leads concomitantly to changes in the hydrological cycles operating within catchments, influencing such parameters of a riverine environment as flow regime, amplitude and permanency, silt load and turbidity, quantity of dissolved salts, nutrients, and particulate organic material transported (Hynes 1970; Goluber 1983; Williams 1983). Such changes to the riverine environment inevitably lead to changes of the riverine biota. Although it is difficult to cite examples from Australia, changes wrought upon the Upper

Ohio Basin may be considered exemplary. There, the forest canopy was reduced from 95% cover (in 1788) to 20% cover (in 1855), and by 1900, 18 species of fish had disappeared from the area, including most of the food and sporting species, to be replaced by silt tolerant species (Lachner 1956).

The Denmark River catchment is largely undisturbed, the majority of the 708 km² being made up of reserves. Only 33% is cleared for agriculture, the remainder being predominantly jarrah-marri forest, so the catchment is in reasonably pristine condition. In accord with this suggestion, water quality is good — salinities are low, ranging from 220 mg/L to 580 mg/L — and it would seem a reliable situation to assess the pristine distribution *vis a vis* the macrohabitat of crayfish. In contrast, 688 km² (53%) and 72 km² (82%) of the Hay and Sleeman River catchments respectively are used for agriculture. It is beyond the scope of the present study to identify the changes associated with clearing, many of which interact (e.g., increases in sediment load and nutrient content), and quantify their individual effect on the riverine biota. However, clearing often results in higher salinities of rivers (Williams 1983) and in accordance with these observations the salinities within the Hay and Sleeman Rivers range as high as 2000 mg/L, considerably higher than in the Denmark River. A simplistic model, which may be true of the limited study area, is that land clearing in the Wilson Inlet catchment leads to an increase in river water salinities.

Cherax tenuimanus exhibited a clear preference for the permanent waters of the channel regions, which supports Riek (1967) and Coy (1979) who refer to the marron as inhabiting rivers and the deeper, broader waters of more permanent streams. The clear preference of this species for waters of a lower salinity is reflected by its biased distribution towards the pristine Denmark River system compared to the Hay and Sleeman River systems of far greater salinity. In contrast *C. crassimanus* favoured the less permanent headwaters. *C. preissii* was not found at all in the Denmark River and appeared to tolerate higher salinities. The sites of lower salinity where *C. preissii* was caught (sites 25 and 26), are both subject to periodic tidal flooding from the saline Wilson Inlet. It seems plausible to interpret the break in the *C. crassimanus* and *C. quinquecarinatus* distributions in Figure 3 as due to sampling errors (i.e., only two sample sites being found with a total dissolved salt concentration of between 700 mg/L and 1300 mg/L).

That all species occurred allopatrically indicate that no direct dependant relationships exist between species. Despite the fact that sympatry occurred at fewer than half the sample sites (42.8%), these sites contained almost all the possible species combinations including the finding of three species (*C. tenuimanus*, *C. crassimanus*, and *C. preissii*) at a single site. A notable exception was that *C. quinquecarinatus* was not found occurring sympatrically with *C. preissii*. However this may be an artifact of the small number of sites at which *C. quinquecarinatus* was located.

Before concluding this account, it is appropriate to highlight the record of *C. quinquecarinatus* from two sites within the Wilson Inlet catchment basin, thereby extending the previously known easterly distribution by 29 kilometres. The species was rare in the main channel of the Denmark River (refer to Table 2), being found at only one site sympatrically with *C. tenuimanus* and *C. crassimanus*. Greater numbers of individuals were found occurring allopatrically at a headwater site of the Hay River (site 15). Elsewhere the species is widespread between the Moore and Inlet Rivers

(Austin 1986). The species may also be present in the Sleeman River, but was perhaps overlooked because of the policy of rejecting crayfish with a carapace length less than 10 mm. The same reason may suffice to explain why this species was not found in greater numbers in the Denmark and Hay Rivers.

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